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TELEGRAPH ENGINEERS.

THE choice of a profession is a point of such serious moment to those who are about to engage in the battle of life, that it is as well that the prospects of any particular kind of work which may appear to offer a field for employment should be well looked into, before a determination is arrived at that studies necessary for that employment should be actively prosecuted.

The profession of a telegraph engineer at the present time shares in the universal depression which has fallen upon engineering work of all kinds, and which, indeed, is felt in commercial circles generally. This has not, however, prevented a continual increase in the numbers of men who more or less are entitled to be considered as telegraph engineers.

The rapid growth of the Society to which the telegraph engineer has given a name, and whose members now number, we believe, close upon one thousand men, if it may be taken as a fair proof of the progress of the branch of engineering now firmly established, certainly does not lead one to suppose that it is a branch which is not in a flourishing condition. A careful analysis, if it could be made, of the actual work in which the men who make up the numbers are engaged, although it would no doubt show that a large proportion of them could not properly be styled engineers, still would show that no small number are more or less actively engaged in work which fairly entitles them to be considered as such. A young society must at first necessarily include amongst its number a large proportion of men whose work, such as that of the telegraph clerk, or the worker in physical science, cannot strictly be considered as that of an engineer, although it may lead to that profession; but making allowance for this, we repeat that a careful analysis would show that the number of men actively engaged in actual telegraph engineering work is by no means small, and it shows no indication of diminution. This in itself is a healthy sign.

Like most other new professions, that of the telegraph engineer commenced its career with a period of parasitical growth, during which large sums of money were made by those who were fortunate enough to have then turned their attention to the subject. Large construction companies sprang into existence, whose fortunes fluctuated, and two of which have lately had to declare themselves bankrupt, thereby throwing adrift a number of hands who have had to seek employment elsewhere. This latter is not an encouraging prospect for those who have aimed, to say the least, at making a living, or for the more ambitious ones who have aspired to obtain something more than a competence by the profession; but, that the reaction which inevitably follows action can be permanent, is not to be supposed for one moment. It will, no doubt, have the effect of causing many who are lukewarm on the subject to turn their attention to other branches of engineering or other avocations for which they are really more suited, and the prospects of those who still keep firm to their chosen profession, will thereby hereafter be benefited.

The constant and unlooked for improvements which are continually being made in telegraphy show that a wide field is open to those who have the talent of ingenuity. It is to those we think that telegraphy offers the best chance of their getting on.

Inventions which enable work to be got through quickly, such as the duplex and quadruplex systems for instance, and which show real points of originality, are especially of value and are seldom unappreciated. It is these inventions in their second stage, however, that is when they are brought into a practical shape, that bring in a good harvest. The inventor with whom the idea originates, unless he carries it into practice, seldom is the one who makes the money.

Amateur inventors are very prone to work upon other people's ideas, instead of striking out new paths—witness the host of duplex and quadruplex telegraph systems which have been devised. This, no doubt is inevitable whilst the profession is being learnt, but it may be carried to too great a length and time wasted which may be more profitably employed.

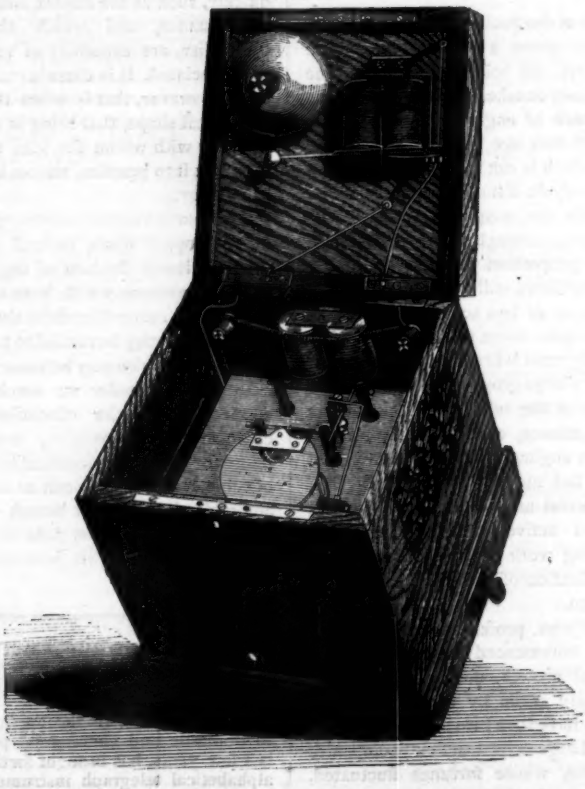
In our last leader we dwelt upon some points connected with the education that a telegraph engineer should receive, more especially with reference to his employment in the foreign service of cable companies. Such an education is of course advisable for whatever branch of the profession is taken up, and it never fails to be of effect in the long run, although its immediate advantage may not be evident.

BREGUET AND CROSSLEY'S ALPHABETICAL TELEGRAPH INSTRUMENT.

THE vast increase in the application of telegraphy to domestic and commercial purposes during the last few years, has brought forth a great number of alphabetical telegraph instruments, the majority of which, being of but very little practical worth, have

FIG. 1.

FIG. 2.



died out, whilst a few have come into general use, the Breguet-Crossley instrument being one of the latter class.

This instrument, the joint invention of M. L. Breguet, of Paris, and Mr. Louis J. Crossley, of Halifax, is of a very compact and neat form, and having been improved at various times during the last fifteen years, is now very reliable for private lines which require an instrument simple in principle and working, and not liable to be easily put out of order, and being at the same time much cheaper than the more elaborate magneto instruments.

The instrument consists of a transmitter, galvanometer, receiver, and alarm, arranged in a mahogany box, divided into three sections.

The top section contains the alarm, the middle section the receiver, and the bottom or base the transmitter and galvanometer.

When open, as in fig. 1, the instrument is in order for transmitting and receiving messages, and when closed, the alarm shown in fig. 2, is brought into circuit.

The fault of "tripping," common to step-by-step instruments, has been entirely overcome in the Brequet-Crossley instrument, and the working speed much augmented by special care in the construction of the electro-magnet.

In order that the instrument may be in a condition to receive a signal on the alarum, it is necessary that the transmitter handle should be at the zero notch. By carelessness it may frequently be the case that this point is overlooked, and the circuit thereby be broken down for hours. In the Breguet-Crossley instrument this inconvenience is avoided by the simple but ingenious expedient of making the box impossible to shut close unless the transmitter handle is properly in the zero notch.

The whole make and arrangement of the instrument is excellent, and well suited for the use of private firms, and it only requires to be more known to come into extended use.

We understand that Mr. W. Groves, of 89, Bolsover Street, London, W., is the sole London agent for the instrument.

INDIA-RUBBER CONSIDERED IN REFERENCE TO ITS APPLICATION TO TELEGRAPHY.

By THOMAS T. P. BRUCE WARREN,

Analytical Chemist to the India-rubber, Gutta-percha, and Telegraph Works Company, Limited.

(*Continued from page* 175.)

I propose to devote this and the succeeding portion of the subject to the different forms of india-rubber covered wires, and to consider the different kinds of faults which are met with.

As an insulator, india-rubber was known and used some time before gutta-percha, but it was its want of stability which made it give way to gutta-percha as soon as methods were discovered to coat telegraph wires with it.

I would refer the reader who is interested in the earlier history of insulated wires, to the report of a committee appointed by the Privy Council Committee and the Atlantic Company to inquire into the construction, &c., of submarine telegraph cables.

A very great deal of evidence was collected in favour of india-rubber, which would be too voluminous to give here. Sir Charles Wheatstone, Mr. C. W. Siemens, Mr. Latimer Clark, Mr. R. S. Newall, Mr. C. F. Varley, Mr. W. H. Preece, and many others who had experience both with india-rubber and gutta-percha, expressed very favourable opinions on india-rubber. At the time (1861) when the report was made, 11,634 miles of submarine lines were laid, of which only 3,000 were reported as working.

No one then could be surprised, as nearly the whole of this was insulated with gutta-percha, that other forms of insulators cropped up ; in spite of this, however, gutta-percha has not only held its position, but has sustained its character in a way which we should have been pleased to have seen emulated by india-rubber.

Looking at the facts with an impartial feeling, I hardly think any manufacturer of india-rubber cables would, from past experience, expect a verdict in favour of india-rubber in any vulcanised form. I may take this opportunity for stating that, although it has seriously failed to sustain the confidence which is required in any new insulator before its extensive application could be entertained, I firmly believe that india-rubber has so many good qualities that it will continue to receive attention with a view to utilise it as an insulator.

The form of wire patented by the author has now stood the test of time and exposure to air and weather in a most remarkable manner. The extensive failures in other forms of india-rubber wires when kept dry must lead to serious apprehensions for such work which india-rubber seems more specially adapted for, such as torpedo cables and military telegraphs. Serious uneasiness is felt in the absence of a reliable wire for this purpose, and not without fair cause, for we have only to imagine the break-down of a wire just as a torpedo should be fired, or the development of faults in a line when orders for strategic movements are to be given.

Torpedo cables must of necessity be kept for a long time dry, or wet and dry, and these conditions vulcanised india-rubber certainly will not stand.

The durability of an insulator is best tested with thin coatings, as with thick coatings it is not so easy to judge of permanence or the mechanical security of applying it uniformly in practice. I placed a length of my insulated wire in the open air during the last twelve months, exposed to the full glare of the sun, and it is now equal in insulation to what it was when first manufactured.

From the fact that all vulcanised wires deteriorated so rapidly, it was reported a short time ago that for torpedo cables it was intended to substitute gutta-percha covered wires. I propose at a future time to deal with the subject of torpedo cables, as the importance of this matter just now claims more attention than the present article can afford space for.

At one time it was rumoured that vulcanised india-rubber could not be jointed. I am not aware how this statement arose, or for what purpose it was circulated. There is no doubt but that in the general *melée* of inventing improvements in connection with india-rubber insulation, a halo of mistrust

entombed every idea which was put forward. For this the advocates of india-rubber insulation were themselves to blame; it was, however, a very long time before anyone could be persuaded that india-rubber in any form had any practical merits at all as an insulator.

Until only a few years ago, joints in india-rubber wires were made a matter of great outcry against its adoption.

Two or three methods are at present in use, namely, "searing," as proposed by Mr. Hooper, smearing the surfaces to be united with india-rubber cement or solution, and that in which the perfectly clean cut surfaces are alone trusted to.

It was a long time before the "searing process" became developed into a practically reliable method. The surface of the vulcanised india-rubber by this method is carbonised, by which the surface is rendered sticky and adhesive. This was considered indispensable in the earlier days of its adoption for reliable jointing. It was soon found that this layer of carbonised matter was a serious drawback, for if, by accident, it extended to the conductor, communication was made between it and the outer surface of the core. This led to the thorough cleaning of the seared surfaces with coal tar naphtha, and latterly to the re-cutting after searing. This method gives a perfectly reliable joint, and when made with care by an experienced jointer, leaves nothing to be desired. From this it will be seen that there is not much difference between this method and the other two which have been mentioned above.

I may remark that the searing process has never been favourably regarded by any other india-rubber manufacturer from the failures in its earlier application.

The following is the plan adopted for jointing india-rubber cores: the conductors are united with solder in the usual way, and the wires carefully tinned or coated with the solder if the filing or scraping to clean the insulator has exposed the copper. This, though not often attended to, is of more importance than manufacturers themselves appear to think. I have very frequently found the india-rubber surrounding the conductor quite sticky after a short time from being in contact with an imperfectly tinned conductor.

This interesting fact alone conclusively shows that the sticky condition of the india-rubber is not due here to atmospherical oxygen, for the insulator on both sides of the joint will, in general (unless the core itself is defective), be found perfectly sound. It may, however, be argued that the air existed in the strand of the wire before jointing, but then the difficulty arises to explain why it should act simply on one portion of the surface so decidedly, leaving others intact.

The conductor being jointed and carefully tinned (resin being used, which should be well cleaned off afterwards), the ends on each side are carefully tapered away by cutting with a pair of curved scissors, the taper being at such an angle that from the end where the insulator just covers the conductor to the uncut portion of the surface is about two inches. The vulcanised rubber is now rubbed with a heated iron, which should be sufficiently hot as to decompose the rubber, but not to ignite the gases generated by it. This process renders the surface sticky, which is next well cleaned with a piece of glazed cotton cloth, moistened in coal-tar naphtha until no stain is given to the cloth. To make sure that all this sooty matter is removed, the taper portion should be again slightly re-cut. The searing pieces should have been continued a short distance along the surface of the core beyond the edge of the taper, and this portion is merely well cleaned, but not cut at all. The coatings are now lapped on, care being taken to keep them clean and well stretched. The whole is well bound with an elastic-like cotton tape, and consolidated or cured. One of the greatest advantages of india-rubber as an insulator is the absolute certainty of the jointing process, and to which Mr. Hooper's method of searing has added an enhanced security.

Faults in india-rubber covered wires.—There are several kinds of defects met with in india-rubber covered wires as compared with gutta-percha. One very serious defect is, its tendency to soften or liquefy. From all the information I can gather this is more generally met with in that form of manufacture which professes to keep the inner portion of unvulcanised rubber from sulphur. I cannot help expressing my surprise at the indifference which is shown to this state of the wire by engineers. I have heard it said repeatedly by many whose authority on electrical matters stand high, that this stickiness is of small consequence. No one who has carefully watched the behaviour of a wire in which this change is going on, could possibly be led to look upon the phenomenon with much composure. When an india-rubber covered wire has been kept in water for a few days at a temperature of 75° F., and shows a constant and unaltered condition by the electrical tests of insulation and induction, it may safely be assumed that the india-rubber is sound, or at least is not disposed to liquefy; but if on the other hand its insulation slightly *decrease*, whilst its inductive capacity *increase*, it may be predicted that in a short time the india-rubber will be thoroughly decomposed. Now this is a change which takes place in water, though not quite so rapidly, perhaps, as if the wire were kept in air, but is considerably accelerated by alternately being wetted and dried. The writer has met with many instances of this change in a certain manufacture and several miles from the ends of considerable lengths of cable. At the joints, the conducting wire (strands) being filled with solder, air cannot be conveyed through any long length of such core, and consequently we cannot well see how this can be the result of oxidation, unless during the masticating process some change takes place in the rubber by which a condition is created for holding oxygen, which at a suitable time plays a part similarly to that of isopropene. According to the experiments of Mr. Greville Williams (Phil. Trans. 1860, p. 241) isopropene, when exposed to the light for some months in a partly filled flask, thickens and acquires bleaching properties, owing to the absorption of ozone. On distilling the ozonized liquid a violent reaction takes place between the ozone and the hydrocarbon. All the unaltered hydrocarbon distils away, and the contents of the retort suddenly solidify to a pure white, amorphous mass.

When india-rubber is masticated a volatile substance is formed, and if the heat has been allowed to become generated incautiously, the odour is

capable of being recognised a long distance from the machine. An examination of this substance may lead to important results.

Another singular fact scarcely consistent with direct oxidation as the cause of the decay in india-rubber, is met with when a plain (untinned) copper wire is lapped with masticated india-rubber, the liquefying, although visible at the ends to a greater extent, is always found more rapid on the surface contiguous to the wire, the excess at the ends is probably an oozing out produced by its fluidity. When this change is perceptible it will be found that heat applied to the wire will greatly accelerate it, whereas cold, as by freezing the rubber, will arrest it.

This change, when once it has commenced in a piece of rubber is considered as being capable of being communicated to another piece of rubber, and on this account M. Payen has compared this change in india-rubber to the same class of chemical phenomena as the growing rancidity of fats.

My experience is, that this change cannot be communicated to a piece of *even* slightly vulcanised india-rubber, unless heat is at the same time applied; but when once this change has been set up, it spreads itself with great rapidity.

It has been a common practice with some manufacturers to reheat any length of insulated wire which has given a low degree of insulation when cured. During the manufacture of some more recent cables, this was found to be followed by such serious consequences in the decomposability of the rubber next the copper that it was discontinued.

By this reheating, an insulated wire which has even fallen in insulation considerably, can be immensely increased in its insulation resistance. At the same time its inductive capacity is very materially raised.

Some electricians say that this lowering of the insulation in india-rubber wires, as it can be again raised by heating, is due to the absorption of water, which is expelled by the reheating. This is not supported by any proof, and can only have arisen from a very imperfect examination of the matter.

Sir William Thomson had a few lengths of core from the Western Brazilian Company's cable cut off and reheated. He found the insulation was increased by this method. This reheating, however, gives a wire a more serious condition for liquefying.

In the year 1865, about 50 miles of core were made for the Indian Government for a cable to be used for river crossings in India. The method of curing was on drums, with layers of felt to prevent the core being disturbed whilst under the heating process. The consequence was, that the heat was unequally distributed and the core imperfectly cured or vulcanised. The core had a tolerably high degree of insulation, but still was not so high as required by the contract. The writer took two coils, and on cutting each in halves found they were equally low; the halves were again cut, without any difference being perceptible in the insulation of any of the sections. On examining the insulator closely, it was found that a great quantity of radiated crystals was scattered through the inner india-rubber. This was decidedly the result of imperfect heating. The coils, when reheated, had completely lost this appearance of crystals in the rubber, and rose to four or five times their original resistance. These results were witnessed by Mr. J. C. Laws, who was acting for Mr. Latimer Clark in testing the cable.

I have seen instances where lengths of insulated wire, which were known to be sound when manufactured, have been kept dry in the air, and when placed in water for only a few hours shown an extremely low degree of insulation. In such cases I have found the india-rubber generally sound and perfect. This is certainly a phenomenon requiring a different explanation, and for which we may take Professor Abel's application of Graham's researches to assist us. Graham found that the velocity of the diffusion of gases was inversely proportional to the square roots of their densities.

In 1862, I made several experiments on the diffusion of gases through thin films of india-rubber, and I invariably found, as might have been expected, that a gas jar filled with hydrogen, sulphuretted hydrogen, and carburetted hydrogen, rapidly lost a portion of its contents, the india-rubber film being "cupped" towards the inside of the jar in a very short time. The escape of illuminating gas through vulcanised india-rubber tubing must have arrested the attention of any one who has had occasion to use it. Sulphuretted hydrogen escapes very rapidly. A few days ago I left connected to a stopcock of a gas holder filled with sulphuretted hydrogen a vulcanised india-rubber tube, which was closed at the other end with a pinch cock. The gas was turned off, and the tube left full of the gas. In a few hours the gas had so permeated the tube that it completely collapsed, leaving but little space for air or any other gas. This portion of the subject will be more fully discussed at a future time.

With these facts we are prepared to explain this change in vulcanised india-rubber wires without requiring the assistance of oxygen. It is well known that when a vulcanised wire is kept in water it parts with a considerable amount of sulphur, and if the water itself contains much iron a copious precipitate of its sulphide in the water is not an uncommon occurrence. Again, when a piece of vulcanised rubber is left exposed to the air, every one who has handled the substance must have noticed that the surface is covered with a whitish kind of efflorescence; if a little of this be heated on a piece of platinum foil, the sulphur will burn away, and if the rubber contained other substances besides sulphur they will remain on the foil. Now sulphur, or, rather, the excess of what is required for vulcanising, has a tendency to force its way through the substance of the rubber to the surface, and so great is this force that it brings with it whatever pigment lays in its path. Thus on the surface of a piece of vulcanised rubber it is frequently possible to find in a pulverulent form a little of all the pigments which have been blended with it.

Sulphurous acid is generally found in large quantities in water in which vulcanised rubber cores have been kept, and especially if the cores have been partially exposed to the air at the same time.

It is impossible that this abstraction of the sulphur can go on without some detriment to the core, and those who are interested in this manufacture would do well to follow up this inquiry, which is so obviously important that I must express my surprise at the little attention which has been given to it.

I should be doing an injustice to the Silvertown

manufacture if I left an impression on the mind of my reader that this matter has not been carefully overhauled. I believe the torpedo cables made by this company are specially manufactured with the view to arrest this objectionable and detrimental change.

It is certain that the oxidation of the extracted sulphur brings about that decay in vulcanised india-rubber which first becoming harsh and dry, ends in becoming hard and brittle, when it easily cracks by handling.

Another kind of fault which indicates itself in india-rubber covered wires, and which is accompanied with a gradual falling off in their insulating properties, is the separation of the coatings. This is a kind of fault which is not followed by any alteration in the substance of the insulator itself, but is known to exist by the coatings being easily stripped away from each other.

This was very commonly met with a few years ago, and led to the author's devising the mode of testing for faults, which is described as Warren's method. Sometimes it would extend only for a few inches, and not unfrequently would arise from the want of adhesion between the separator and vulcanised compound. The same thing frequently occurs in joints where the strips of masticated rubber, from being soiled or lapped on with damp or greasy fingers, refuse to consolidate when heated.

I am not aware that any one has noticed this description of fault with india-rubber, and I think the introduction of Chatterton's compound for gutta-percha cores must have arisen from a knowledge of the importance of securing absolute adhesion between the coatings.

In the earlier days of applying india-rubber, the wires were merely covered by lapping, without being consolidated.

When india-rubber wires are properly consolidated, it is found that the separate coats completely lose their individuality except only in appearance. If it is found with a recently manufactured wire, the coatings are at all capable of being detached from each other, although the wire may have at the time a high degree of insulation, it will be found, as the wire increases in age, so this separation will become more and more easy. It is not easy to explain this. The fault may arise either from overloading the india-rubber with French chalk, or similar pigments, imperfect grinding or masticating, moisture, soiling by being handled, or being splashed with oil from the machinery. Absolute adhesion between all the parts of insulating covering is indispensable for durability of insulation.

The form of separator proposed by Mr. Hooper, would obviously, from what has been said, be quite unsuited for any practical purpose. Consequently, we find no length of cable manufactured under this form.

The form proposed by Messrs. Silver was simply the omission altogether of any separating medium.

In 1861, the author saw the disadvantage of inserting hemp, iron wire, tape, and varnishes between the coats of an insulating covering, and in May of that year, in conjunction with Mr. Robert Hancock, at the request of Mr. Hooper, worked upon the development of a form of separator which should perform the office of an union compound. The action as a separator, of this compound, has been severely criticised; suffice it to say, that this form of wire has been more extensively used for submarine work than any other. The skill and care which was bestowed upon the manufacture of this wire gave it a very enviable position, and established for it a character for durability which must seriously have ruffled that comfortable indifference with which the supporters of gutta-percha contemplated the birth of a threatened rival insulator. The behaviour of recent cores of this manufacture has created some misgivings as to its ultimate success.

In this form of wire, as manufactured by some makers, a small quantity of sulphur is introduced into this union compound, and I believe the results have been more satisfactory with wires so covered than where this sulphur has been omitted. The Silvertown wires were very extensively used by the United Kingdom Telegraph Company for their overhead system, which, since the acquisition of the telegraphs by the Government has gradually been superseded by the ordinary underground wire. No other form has had any very extended trial. Messrs. Siemens proposed covering a conductor previously coated with gutta-percha, by applying over it longitudinally a strip of india-rubber, the absence of any consolidating process, and the rubber rapidly decomposing, led to the abandonment of this construction.

The wires manufactured by Messrs. Hall and Wells have, I believe, been used for several purposes, principally for military and mining cables; but I am not aware of any extensive application being made of these wires. The conductors, covered with cotton, were first coated with masticated india-rubber, which was again protected with a lapping of vulcanised rubber, no consolidation being given, or rather the coatings not adhering together, indicated its non-suitability for marine purposes.

Wray's compound, which was a mixture of some siliceous matter with india-rubber, was thought to possess some important qualities for insulating purposes; and the patent for working this was, it is said, taken up by the Gutta Percha Company, who manufactured a few short lengths of it.

A wire laid in the pipes along the Strand, by the Electric and International Telegraph Company, failed within a few days after being laid down. The failure of this wire being so rapid, we may fairly conclude that this was more likely the result of some mechanical flaw than decay.

I have, since writing this, been informed by Mr. Wray that this wire continued to work for six years, after the flaw, which probably resulted from drawing into the pipes, had been removed.

The manufacture of Mr. Daft consisted in applying vulcanisable compounds of india-rubber over a brass wire. This, I believe, has never been adopted. A little fact was at the bottom of this idea, which, however, is not without importance. It was proved that vulcanised rubber, during the process of curing, gave up a little of its sulphur and attacked the substance of the conductors, which were ultimately coated with a powder of the sulphide of the particular metal employed. This was not found to be the case with brass, but the vulcanised rubber was found to adhere most tenaciously to the wire. Copper wires coated with brass were found to behave in the same way.

Important as this fact is, I am not aware that it

has been turned to account, or any attempt made to explain why vulcanised rubber should behave so differently with an alloy of zinc and copper, for on a bare copper wire the sulphur soon displays its action, and on a wire coated with zinc not the slightest adhesion is perceptible.

The reader who is interested in following up the matter of these and other modes of insulating by india-rubber, is referred to the specifications of the respective patentees.

The methods and appliances for covering telegraphic conductors with india-rubber will be dealt with in a subsequent paper.

TELEPHONIC INVENTIONS OF GRAY, BELL, AND EDISON.

THE attention of electricians having been of late years called to the transmission of musical tones or sounds between distant points by means of electricity, a number of our most noted inventors have made experiments to demonstrate what could be done in that direction, and what, if any, practical value such acoustic telegraphy possessed for the purposes of ordinary commercial telegraphy. Among these inventors three have obtained results of interest to the scientist and the public generally. They are Thomas A. Edison, of Menlo Park, N. J.; Elisha Gray, of Chicago; and A. G. Bell, of Boston. The original idea of each was to devise a system of multiplex transmission of despatches by means of a Morse apparatus in common use, the *modus operandi* being to use tuning forks or other vibratory apparatus for generating a number of tones. Placing one instrument of each tone at the transmitting and receiving station, then by connecting these forks at the transmitting station with a battery, an impulse or wave of electricity was made to pass from the battery over the intermediate wire to the receiving instrument at each vibration of such transmitting fork, the forks at the receiving station being operated by means of electro-magnets controlled by the current passing over the intermediate wire. Each fork at the transmitting station having its mate at the receiving station, tuned to respond to the same number of vibrations per second as that at the transmitting station, the vibration of any fork of a given tone would send over the wire and through the electro-magnets at the receiving station such number of electric impulses as would set in motion the particular fork attuned in sympathy with that tone or number of vibrations, and although the other magnets and their forks were in circuit, they would not be affected, because the forks would only respond to the number of vibrations per second to which they were attuned. A second transmitting fork being set in motion would start its counterpart at the receiving station; a third also, and so on to the number of eight. By the alternate starting and interrupting these tones, it was aimed to transmit the ordinary Morse signals, the operators at the receiving station to read them by the ear, as in the common Morse sounder. Each of the gentlemen named succeeded to a certain extent in doing this, but all made it finally clear that in this direction comparatively trifling results of value were to be obtained. Hence from this general notion each diverged into other paths, resulting finally, in the case of Edison and Bell—without following them through the labyrinth of experiments—in the speaking telegraph, or telephone, whereby the human voice is transmitted to a distant station, and there reproduced in an audible manner.

Astonishing as it may seem, it is nevertheless the fact that these two experiments have obtained their results by widely different methods. Bell generates his electricity by vibrating an iron diaphragm placed close to the poles of a powerful permanent magnet, and receives the impulses thus simultaneously generated and transmitted upon a similar diaphragm placed close to the poles of an electro magnet. This device is necessarily very restricted in its capacity.

First.—Because of the small quantity of the electricity possible to generate by the power of the human voice, thus limiting the power of the current to traverse a wire of any considerable length.

Second.—Because of the use of an electro-magnet for a receiver. It being well known that the element of time is an important matter in the charging and discharging of an electro-magnet, it will be readily understood that the great rapidity of these electric charges overtaxes its capacity. Hence high notes are frequently lost, or so reduced in volume as to be scarcely audible.

For these two reasons it will be seen that Mr. Bell's apparatus is limited to very short lines in its practical application.

Mr. Edison being a man of marked practical turn of mind, foresaw these limits, and in experimenting for substitutes for them having greater range of effectiveness, has created probably the greatest invention in electricity of the nineteenth century, namely, the electro-motograph telephone. A brief description of it will show how entirely different in principle it is from that of Mr. Bell's, just described. The transmitting apparatus consists simply of a long tube about two inches in diameter, having one end covered with a thin sheet brass diaphragm, which is kept tight by a stretching ring.

In the centre of the brass diaphragm is riveted a thin disk of platina, and immediately in front of this disk is an adjustible platina-pointed screw secured to a rigid pillar.

To transmit the music it is only necessary to sing or play into the open end of this tube. This causes the diaphragm to vibrate, and, the platina points meeting, make the circuit, and the electric current transmits every vibration over the wire to the receiving end.

The receiving apparatus employed by Mr. Edison for reproducing the tones is based upon an original discovery made by him some five years ago. This discovery was that when a piece of paper moistened with certain chemical solutions is laid upon a metallic plate connected to the positive pole of a battery, and a platina-faced wire connected to the negative pole of the battery is drawn over the paper, the passage of the current through it causes all friction to disappear, and the platina-faced wire slides over the paper as iron upon ice; but if the current be interrupted this effect instantly disappears, and the normal friction of the paper causes the wires to be drawn over it with difficulty. This principal is applied to the receiver—a resonant box, a drum or wheel, having flanges on both sides. This wheel is secured to a shaft rotated by a

handle. A continuous strip of paper from the reel passes over the drum, the surface of which is roughened. Resting upon the drum is a smooth platina point upon the end of the spring, which is secured to the centre of the resonant box, and presses the platina point with considerable force upon the chemically prepared paper. The current from the battery passes to the spring, to the platina point, thence through the moist paper—which in this state is a conductor—thence to the drum, and back to the battery.

The operation is as follows: When the handle is turned the paper passes forward, and the normal friction between the point and the paper serves to give a forward motion to the spring; hence one side of the resonant box is drawn out. If now a wave of current passes through the paper all friction ceases, and the spring not being pulled, the side of the resonator regains its normal position; and this takes place at each vibration. By means of this friction the most feeble currents, which would not produce the slightest effect upon an electro-magnet, thus exert extraordinary strength. This apparatus will respond and reproduce with great power the highest notes of the human voice, which are nearly inaudible when magnets are employed, the slowness of their operation being due to the time required for the magnetisation and demagnetisation of the iron cores, and the production of secondary currents, which delay the action and mutilate the signals.

This description refers more especially to the apparatus for the transmitting of the human voice in tones or singing. The only difference between this and the speaking telegraph proper, however, is in the substitution of a plumbago point for the platina point in the adjustable screw of the transmitter. This, again, is another original discovery of Mr. Edison's, viz.: that plumbago changes its electrical resistance with enormous rapidity under pressure, the effect in this application being that when the diaphragm is vibrated weakly, contact is made with the plumbago point very lightly, and the resistance of the plumbago being but slightly reduced, a weak current is sent out from the battery, and a weak effect produced at the receiving station. When, however, a strong pressure of the diaphragm is effected, by reason of the exercise of a more powerful vibration of the voice, the resistance is very greatly reduced, and a strong current passes to the line, and a strong or loud effect is produced at the receiving station. Hence the amount of power, with all its fine gradations generated by the voice at the transmitting station, is transmitted in its proportions to the receiving instrument, and thus the fine articulation of the voice is obtained. This is of itself a wonderful invention, and will be of great value to electricians in other fields. The ability to send from a battery currents of different strength automatically is a new and valuable invention in electricity.—*Philadelphia Press.*

LIGHTING BY ELECTRICITY.*

(From "La Nature.")

THE Gramme machine, of which we have spoken many times in this magazine, is the best source of electricity known at the present time. A great number of different models have been constructed; the most prevalent is represented by the subjoined figure. It shows the electric machine mounted upon a cast-iron stand, light and hollow, which has no other use than to raise and remove it from the ground. The machine is composed of a fixed electro-magnet, between the poles of which turns the particular electro-magnet called Gramme's ring. The fixed electro-magnet is made up of four bobbins, the upper two concurring to create between them a single pole (north, for example), and the lower two a single pole (south).

The simplicity of this apparatus, its great solidity (it is entirely constructed of metal), its silent action, the inutility of any other care than the inspection of the lubrication, are the principal advantages that it presents over its predecessors.

The employment of this machine furnishes to-day the most economic light known. M. Fontaine has given a comparative table of the prices of different processes referred to the unit of light or Carcel burner, from which we print the following figures:

Price of one unit of light for 100 hours.

	fr.
Colza oil, pure	7·0
Petroleum oil	5·40
Schist oil	4·68
Tallow candle	14·10
Wax „	33·0
Stearine „	24·60
Coal gas at 0 fr. 15 the cubic metre for 500 hours a year	2·90
Coal gas for 4,000 hours a year	2·50
Coal gas at 0 fr. 30 the cubic metre for 500 hours a year	5·0
Coal gas for 4,000 hours	4·60
Voltaic pile	6·0
Alliance machine (500 hours a year)	2·40
Alliance machine (4,000 hours a year)	0·70
Gramme's machine, driven by a steam engine, 500 hours a year	0·42
Gramme's machine, 4,000 hours a year	0·16
Gramme's machine, driven by a hydraulic motor, 400 hours a year	0·40
Gramme's machine, 4,000 hours a year	0·11

Before entering into any commentary on this table, let us say that the unit of light adopted in France by the administration of lighthouses is the light furnished by a Carcel lamp, burning 42 grammes of pure colza oil per hour.

In England the unit of light is a spermaceti candle, burning 16 grains per hour; it is nearly eight times smaller than the French unit.

In Germany they employ still another unit; it is

* 1 vol., 8vo., by Hippolite Fontaine. Paris, 1877. The work that we point out to the readers of *La Nature* is destined to indicate the actual state of lighting by means of electricity, and to facilitate the very rapid progress which has been made for some years back in that direction. This book will interest all who follow the advance of science and industry; it is necessary to mechanics who wish to utilise the new methods of lighting, and realise to their profit the considerable economy which results from them when properly applied.

We extract from this book some portions, less for the sake of making acquaintance with it as to inspire a desire to read it entirely.

also a spermaceti candle, giving a light nine times smaller than the unit of Fresnel.

If we took literally the indications of the table, we should conclude that the electric light cost 300 times less than that furnished by wax candles, and 40 times less than gas light at 0 fr. 30 the cubic metre, the price that private people pay in Paris.

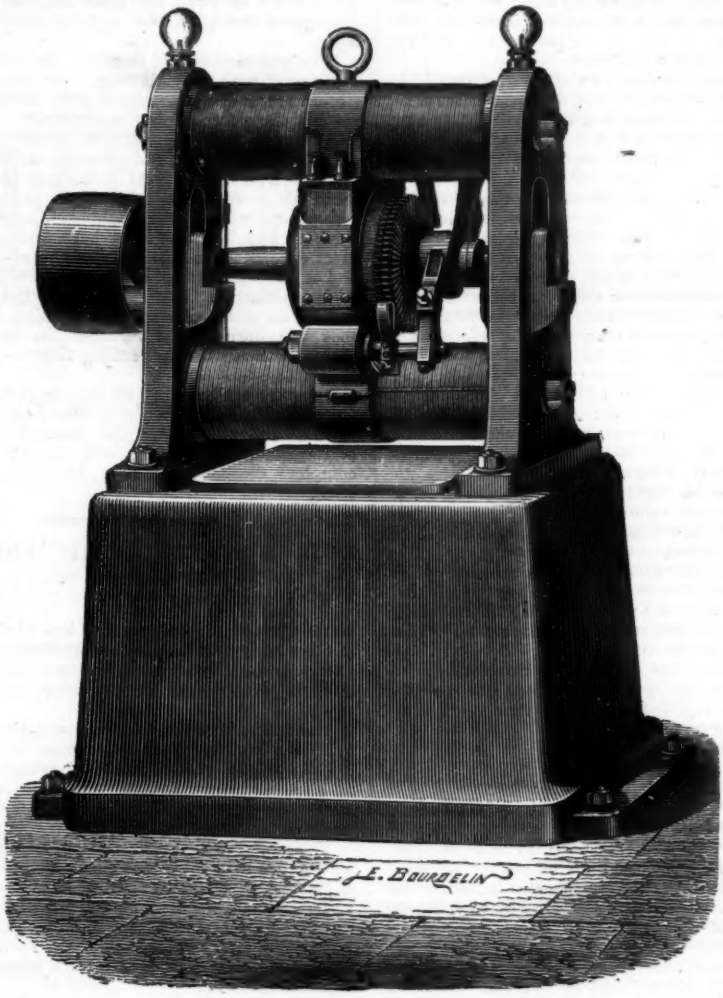
But it is certain that when the electric light is substituted for gas, which is most frequently the case, a much more abundant light is required, and, as a matter of fact, so great an economy is nowhere effected.

M. Fontaine establishes a more exact comparison in contrasting two estimates made for the lighting of a cotton manufactory of 800 hands.

Gas ought to have cost 6,950 francs; the electric light cost effectively 4,600 francs, taking into account the purchase-money of all the driving machines, electric machines, lamps, &c., &c.

The economy is only some 33 per cent., but the light is six times more abundant than it would have been with gas, and the chances of fire are suppressed.

The mention we have made of the sinking of the capital of establishment or purchase-fund will be remarked; it is this which explains the differences indicated in the table, according as the light lasts 500 hours a year or 4,000 hours—that is to say, every night. In certain cases the buying-up charges are the most important part of the expense; they are especially so when the motive power provided is by a hydraulic motor.



We will go even further, and will show that the electric light is sometimes preferred, although it entails increased expense in comparison with former lights. In fact, in industry, the question is not always small expenditure, but rather plentiful production. If, then, one can do a certain kind of work better and quicker with a light like broad day than with the dubious light given by gas jets, one will have every interest in incurring the expense necessary for the substitution of electricity for gas. An instance of this is seen in the case of the railway station of La Chapelle, at Paris.

The *Compagnie du Nord*, on the initiative of M. Sartiaux, *ingenieur des ponts et chaussees*, has established, at great cost, some machines for lighting two sheds or warehouses and a court which separates them, and in which work goes on all night and all the year, preparing goods.

Here are the results obtained on the authority of official documents: "The great brightness shed allows work to be done with more celerity and fewer men. The economy of *personnel* is valued at 25 per cent. We have made arrangements to use only two sheds instead of three for the service of the expeditions, which will save the construction of a new hall. Operations are carried on almost as if in broad daylight: inspection is easier, and the consequences are as follows: diminution of errors in direction, and the delays resulting from them; diminution of damage to the cargo; diminution of embezzlement, and of certain frauds committed by dishonest goods agents aiming at obtaining excessive indemnity from the company."

We may remark that if the *Chemin de fer du Nord* saves the construction of a hall, the purchase-money of the electric machines and motors will be more than balanced.

The economy of a fourth on the salaries of the workmen leaves far behind the daily expenses that the light necessitates; and to sum up all, in making an important expenditure, much more considerable expenses are saved.

We can only refer to M. Fontaine's book for a description of the principal applications already realised; we will indicate those that we believe are destined soon to be made.

In hot countries it will be of interest in allowing work to be done by night rather than by day; workmen will suffer less by the heat, and will produce more. If it be a question of working in close and covered places, the electric lamps will give little or no heat, and will fill well the programme of taking care of the workmen. But some intelligent and daring farmers in the Bordelais and elsewhere have even got the idea of carrying on certain agricultural labours in the open air by the light of electric lamps.

One of our Spanish friends recently entertained us with a project at least as original, which he intends to put in practice at Barcelona during certain months: he means to light a sea-shore so as to permit sea-bathing by night; that is to say, at an hour when bathers will not have to suffer the intolerable heat of the sun.

The officers of the fire brigade think to light up by electricity the surroundings of fires which burst out at night. The idea of lighting up a fire appears singular; but in reality it amounts to illuminating the neighbourhood, and consequently the points where the firemen operate; it appears that fires which break out by day are much more quickly extinguished than those which declare themselves at night. In the obscurity, orders are given with more difficulty, the work is less promptly and effectively performed, the police lack confidence. There is ground for hoping that, before long, some trials will be made, and that it will be possible to give to the firemen of Paris the same facilities for their courageous operations by night as they have by day.

If we pass now to cold countries, we find ourselves confronted with very different circumstances, but circumstances still more favourable to the employment of the electric light; we know, in fact, that in all countries situated near the polar circles the nights are very long during winter, and the days do not suffice for the habitual labours of men; there, more than anywhere else, the production of artifical day will be an inestimable benefit. So in Sweden and Norway, they have welcomed with great eagerness the possibility of the electric light, and especially in the great saw mills which export so much timber. In these factories the necessary fuel for the steam engines costs nothing, in fact, for they can burn in the furnaces the sawdust and chips which remain after selling the trees in planks or boards.

To sum up, all usages, all human industries can find new facilities, thanks to the new process of lighting, and we ardently wish that this new marvel of the nineteenth century will take in France its complete development, as it has taken there its birth.

EGGINGTON'S AUTOMATIC LIGHTNING GUARD.

THIS ingenious lightning guard was devised for use at cable houses which are at some distance from the office, in order to avoid continual journeys over difficult ground, and at any hour of the day or night.

The apparatus consists of six iron plates—b_1, b_2, b_3, b_4, b_5, and b_6—fixed to an ebonite base board. To each of these plates are fixed springs—s_1, s_2, s_3, s_4, s_5, and s_6 (see also s, fig. 2); these springs are connected by means of fine platinum wires to brass terminals fixed on a brass bar $a\ a\ a\ a$.

The platinum wires are of such a length that the springs are held back from contact points p_1, p_2, p_3, p_4, p_5, and p_6 (see also p, fig. 2).

The brass bar on which the six brass terminals are mounted is connected with the cable by terminal No. 1. The terminal No. 2, to which is attached the land line, is connected internally to the first iron plate b_1.

Contact point p_1 is connected to plate b_2, p_2 to b_3, and so on throughout all the points and springs; the last point p_6 is connected to terminal No. 3, which is joined to earth.

Over the whole of the six iron plates an iron plate 2, fig. 2, is laid, but separated from them by thin ebonite washers. Both the large and the six small plates have their surfaces grooved in the direction of their lengths, as in the ordinary Siemens' plate dischargers.

Suppose a strong discharge to take place, the platinum wire connected to spring s_1 becomes fused, and the released spring makes contact with the platinum point p_1 immediately in front of it, and the land line and cable are thus placed in circuit through platinum wire No. 2, which if in turn fused, allows spring s_2 to fall back, thereby putting the third platinum wire in circuit, and so on.

When, finally, the last wire is fused, the cable becomes insulated, and the land line put to earth.

Fig. 1.

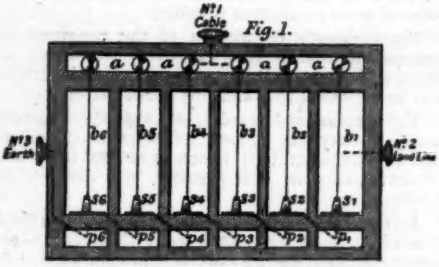
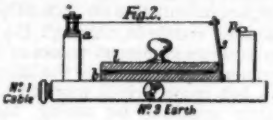


Fig. 2.



The dimensions of the apparatus are as follows :

Height	- -	5 inches.
Breadth	- -	13 „
Length	- -	17 „

This form of lightning guard has now been in use for several years, and has answered its purpose thoroughly well.

Review.

Electricity and the Electric Telegraph. By GEORGE B. PRESCOTT. (New York : D. Appleton & Co. ; London : E. & F. N. Spon, Charing Cross.)

SINCE the days when the electric telegraph was fairly established, the amount of literature which has appeared bearing on that subject, and also upon electricity as especially applied to the working and maintenance of working of the electric telegraph, has been by no means scanty ; yet the appearance from time to time of new works on the science which, as a rule, command a ready sale, shows that there is plenty yet to be written about electricity and the electric telegraph.

The Americans, although they have ever been in the van as regards the practical working of the electric telegraph system, have by no means kept pace with their transatlantic brethren as regards the literature of the subject. We say have *hitherto* not kept pace, but the production of the work before us has gone far to wipe out this reproach, if it has not completely done so.

Mr. Prescott has produced a work of which the American telegraphists may well be proud, and which reflects the highest credit upon himself, both as regards the choice of matter which he has taken from foreign works and for the very excellent way in which he has put it together. It is no reproach to a book that it is very largely composed of scissors and paste work so long as this is well put together, and the book before us, as indeed Mr. Prescott states in the preface, is very largely indebted to the writings of foreigners. We think however, that Mr. Prescott would have done a graceful action if he had, in a few more cases than he has, stated to what writers he owes the information he has so largely made use of. We, in several places throughout the book, have noticed that articles which have appeared in this journal have been copied verbatim into the work without any acknowledgment of the source from which the information was drawn being mentioned. We notice indeed, towards the end, an acknowledgment of the extract of Mr. Kempe's articles on Resistances and their measurement from this journal, but at the earlier part we observe a full description of the Thomson galvanometer, with plates, from the pen of the same gentleman, which also appeared in the pages of this journal, but for which no acknowledgment has been made, and also in one or two other cases we have found similar omissions. We do not think Mr. Prescott would have lost anything—rather the contrary—by such admissions of his indebtedness in his excellent work.

Being of American origin, the book naturally deals largely with American systems of telegraphy, but such matter by no means forms the bulk of the volume. As it is written rather with the view to impart information of the state of the telegraph system as a whole, this is not to be wondered at.

The introductory chapters are of the kind common to books of this class, and deal with frictional electricity, static induction, electrical machines, &c. The chapter on batteries gives a very good description of almost every kind of battery in use. The gravity battery, which is the almost universal form in America, is naturally very fully described. This element is met with in a great variety of forms ; we notice the Menotti (*sic*) of course amongst the number, and wonder whether authors will be ever agreed upon the way of spelling this word ; we have certainly seen it spelt four ways, viz., Menotti, Minotti, Menotto, and Minotto ; it would be interesting to know which is correct.

We notice, in describing the Leclanché battery, that Mr. Prescott speaks of the positive and negative poles of a battery as consisting of carbon and zinc plates, an expression which is hardly correct, and is misleading.

We are glad to see that the expression "intensity" of a current has not been made use of, but that "current strength," which is a term that cannot mislead, is used ; indeed, throughout the work misleading terms, which are so often found in electrical works, seldom occur.

In the chapter on apparatus for electrical measurement, a section on wire gauges is introduced, in which the lack of uniformity in those employed by different manufacturers and countries is drawn attention to. It would be a great advantage if one uniform gauge could be adopted ; but the conservatism which has prevented something

practical being done in the matter still remains unyielding, and no move seems likely to be made in the matter, which is a source of great inconvenience.

A great deal has been said about the arranging and advisability of working several lines from one battery. On this point, at the conclusion of a chapter in which the subject is very thoroughly dealt with, Mr. Prescott says, "It will be seen that the great waste of money in working many wires of all lengths out of one battery is not the most grievous loss, but that the injurious effects upon the practical working of the wires, especially during wet weather, far outweighs it. Few persons, we apprehend, really know how much of the trouble which arises from this great evil of working so many wires from one battery is erroneously attributed to bad insulation and other causes.' These remarks, coming from one who is eminently qualified to judge upon the subject, are worthy of every consideration.

From the chapter on insulators we learn that glass is the favourite material employed in America, though it does not appear altogether to be a satisfactory one. Mr. Prescott agrees that the best material is the white porcelain so much used on the Continent, and which although more expensive, no doubt will eventually supersede both glass and brown earthenware.

Although we should have liked to have gone through the book and pointed out, chapter by chapter, its many excellencies and few defects, space forbids us to say more on the subjects of which the book deals in common with other works published on our own side of the Atlantic.

Turning to the chapters which deal more particularly with the American forms of instrument, we are struck by the neat and compact form in which the instruments are made, and by the lightness of the Morse keys, which seem to point to the rapidity and skill with which the American operator works.

We notice that the American Morse alphabet differs from that employed in Europe and its dependencies; but it is not found to cause any inconvenience, in consequence, no doubt, of the isolated position of America from the rest of the world.

Speaking of the closed circuit system, which is in almost universal use in America, it is stated that as many as forty stations are placed on one circuit, a great contrast to the European practice, where even on the least busy circuits six instruments are considered quite a sufficient number.

Mr. Prescott's description of the repeaters, so extensively used in America, is very interesting and clear, and shows well the extent to which ingenuity can be exercised to obtain any particular end.

The duplex and quadruplex systems naturally secure a very fair amount of attention, and here Mr. Prescott is quite at home, as several important improvements in the systems are due to his genius.

In the portions of the work where theoretical matter is dealt with, such as is involved in the testing of lines, &c., Mr. Prescott has shown that he is by no means a novice, but is thoroughly competent to impart information on such subjects.

Here we must conclude, although the book well deserves to have its numerous points of usefulness brought prominently forward for the information of our readers, but space forbids more to be said, and we can only conclude by saying, that to the American telegraphists especially, the book must prove of extreme value and interest, and English telegraphists will by no means make a mistake if they add it to their libraries. We think Mr. Prescott has done good service to the telegraph profession in general, and to the American branch of it in particular, by the care and trouble which he must have exercised in bringing out his excellent work.

TRAFFIC RECEIPTS.

1877.	Anglo-American Co.	Brazilian Sub. Co.	Cuba Sub. Co.	Direct Spanish Co.	Direct U.S. Co.	Eastern Co.	Eastern Ex. Co.	Gt. Northern Co.	Indo-Euro. Co.	Mediterranean Ex Co.	Submarine Co.	West Coast America Co.	Western and Brazilian Co.	West India Co.
	£	£	£	£	£	£	£	£	£	£	£	£	£	£
JAN. ...	37,780	11,469	2,311	983	13,530	42,580	24,147	12,663	... ...	... ...	9,668	2,533*b*	10,100	4,058
FEB. ...	32,330	11,606	2,214	784	15,520	35,050	19,645	12,800	... ...	... ...	8,624	2,980*c*	11,026	3,870
MARCH ...	18,880	11,258	3,025	913	8,110	35,491	22,886	16,115	... ...	... ...	9,915	3,128*d*	11,643	5,854
APRIL ...	18,980	11,539	4,706	1,011	6,930	39,861	23,068	16,151	... ...	... ...	11,324	2,362*e*	10,295	7,729
MAY ...	45,420	12,251	4,109	997	17,370	46,309	25,445	18,427	... ...	... ...	11,048	2,179*f*	10,534	*4,670
JUNE ...	40,040	9,742	*3,200	887	15,260	45,477	24,126	19,663	... ...	... ...	9,960	4,025*g* / 2,225*h*	10,522	*3,671
JULY ...	38,790	9,226	*3,900	834	14,820	42,713	22,224	19,187	... ...	... ...	9,943	... ...	7,881	*5,239

* Estimated. *b*, four weeks ending 13th January. *c*, four weeks ending 13th February. *d*, four weeks ending 10th March. *e*, four weeks ending 7th April. *f*, four weeks ending 5th May. *g*, four weeks ending 2nd June. *h*, four weeks ending 30th June.

Notes.

IT is announced that a new thermo-pile, based on Clamond's system, will shortly make its appearance in this country.

A STATUE to Arago is being erected at Perpignan, in the department of Orientales Pyrenees. A subscription has also been opened at Lyons for a statue to Ampère, who was born at that town in 1775, and whose father was there guillotined on the Place des Terraux for having taken part in the great royalist rebellion against the Convention.

AMONGST instrument-makers it is known that even the best sorts of platinum silver wire have somewhat different resistance co-efficients for temperature; Dr. Matheissen's result does not always hold correct for specimens cut from the same coil. It is, moreover, not a settled point whether a wire continues constant in its properties of electrical resistance or changes slightly by lapse of time. Would it not be an advantage to the electrical profession if makers could at any time make an absolute determination of the resistance of their standard coils? We believe that a new determination of the B. A. Unit, by Professor Foster and others, is in progress. Might we suggest that the apparatus by which this is to be carried out should be kept in working order at University College, or some other convenient place, as a Standard at which standard coils may be compared.

WE learn from abroad that the gain by duplex working on the Aden to Bombay cables is from 75 to 95 per cent on the traffic. Time lost in switch-turning in simplex working is saved in duplex working. A clerk is also saved at each station in the working of the two cables.

THE *San Francisco Bulletin* says: "The United States now runs and operates 1,300 miles of wire in Texas, and about 1,400 miles in Arizona and New Mexico. Recently, near Santa, Fé, New Mexico, the New Mexico and Arizona systems were connected, so there is now a continuous southern line across the Continent. At Santa Fé, the Western Union lines running from Denver, Colorado, into New Mexico, connect with the government wires, although the latter operate the line from Santa Fé, New Mexico, to Puebla, Colorado. It is now in contemplation to connect the Texas and New Mexico divisions by building a line down the Rio Grande from Mesilla, New Mexico, and El Paso to Fort Stockton, Texas, a distance of 250 miles.

LIEUTENANT READE, under General Myer's direction, has built 400 miles and rebuilt 600 miles of telegraph in Texas. The rebuilding consists in putting in new poles to take the place of inferior material which was hastily put in some years ago. An ingenious method of utilising the scrubby mesquit wood, in connection with soft and perishable timber like cottonwood and poplar, has been devised. The last-named woods will decay below the surface of the ground in two years' time, but when exposed to the dry atmosphere they will last a great many years. The mesquit is almost impenetrable, but its gnarled, misshapen, and dwarfed nature renders it unfit for use as a pole. In order to utilise both, the mesquit is put into the ground as a stump, and the poplar fastened to it by means of wire clasps and iron spikes.

THE *Journal Telegraphique* gives 269 as the number of cables laid in 1876, representing a length of cable equal to 63,990 nautical miles. The entire network of submarine cables is owned by 21 private organisations and 17 governments. These 21 private companies own 149 cables, or a length of line equal to 59,547 nautical miles. The most influential of these is the so-called Eastern Telegraph Company, which alone represents 39 cables of a total length of 14,503 nautical miles. The next largest is the Anglo-American Company, with 17 cables, amounting to 12,315 knots. Of the governmental companies, the Indo-European has 6 cables of 1,721 miles; France has 26 cables, having a length in all of 673 knots; and Germany 21 cables, amounting to 149 knots. Of the entire number of cables, 45, involving 20,895 knots, are worked independently by the St. Petersburg Telegraph Company; the others are either wholly or in part worked in accordance with specified contracts made.

WE learn that the proprietors of the speaking telephone are putting instruments into use in Providence, Rhode Island, to a limited extent, selecting a few specimen cases to ensure the instrument a full test for practical purposes. Some small telephones, which have been introduced, are not over five inches in length, and weigh less than half-a-pound; but they do all the work, for practical purposes, of the larger instruments.

AFTER discoursing so long about the stars, Mr. Proctor is beginning to descend more and more to terrestrial affairs, and it is not surprising that we should find him expounding the "New Marvels of Telegraphy," in the *Gentleman's Magazine*. We do not know how far his acquaintance with the subject entitles him to predict the future, but this is what he says respecting the articulating telephone: "So far as can be seen there is every reason to believe that before long Professor Bell's grand invention

will be perfected to such a degree that words uttered so low on the American side of the Atlantic that the nearest bystander cannot hear them, will be heard distinctly, after traversing 2,000 miles under the Atlantic, at the European end of the submarine cable, so that Sir William Thomson at Valentia could tell by the voice whether Graham Bell, or Cyrus Field, or his late colleague, Professor Watson, was speaking to him from Newfoundland. Yet a single wave of those which toss in millions on the Atlantic, rolling in on the Irish strand, would utterly drown the voice thus made audible after passing beneath 2,000 miles of ocean." There is that little difficulty of induction which seems to stand in the way of this marvellous realisation. If ordinary signals "run together," what will vibratory signal do? But, of course, induction is a small matter compared with a striking paragraph.

Nature announces that at recent meetings of the Literary and Philosophical Society of Manchester, some interesting contributions were made on early allusions to the magnetic needle. Mr. H. Grimshaw referred to a work entitled "An Apologie of the Power and Providence of God in the Government of the World; or, An Examination and Censure of the Common Error touching Nature's Perpetual and Universal Decay" (1676), in which is to be found an interesting version of Strada's account of a magnetic telegraph, given in a back number of this journal. It was thought that two needles touched by the same loadstone would move in sympathy with each other wherever they might be, so that two people at a distance could converse by means of preconcerted motions to be given to the needles. Sir Thomas Browne submitted the idea to experiment, and found it to fail. Sir Thomas, in his "Pseudodoxica Epidemica," declares that though the needles were separated but half a span, when one was moved, "the other would stand like Hercules' pillars." Joseph Glanville, in his "Scepsis Scientifica" (1665), discussed Sir Thomas' objections to it, and wrote the following words: "Though this pretty contrivance may not yet answer the expectation of inquisitive experiment, yet 'tis no despickable item that by some other such way of magnetick efficiency it may hereafter with success be attempted, when magical history shall be enlarged by riper inspections; and 'tis not unlikely but that present discoveries might be improved to the performance." Professor Stanley Jevons tried to trace the idea in Strada to its originator. Strada attributed it to Cardinal Bembo, secretary of Leo X. The earliest book Mr. Jevons could find containing any allusion to the magnetic telegraph is the "Natural Magic" of Baptista Porta (1589). In the seventh book Porta, describes the wonders of the magnet, saying in the preface: "I do not fear that with a long absent friend, even though he be confined by prison walls, we can communicate what we wish, by means of two compass needles, inscribed with an alphabet." Mr. Jevons found allusions to a magnetic telegraph running through many scientific books of the sixteenth and seventeenth centuries.

THE *Temeraire*, before she leaves Chatham, at the beginning of September, is to be fitted with two powerful electric lights. They will be placed in a commanding position, one on each side of the bridge, and will light up every portion of the vessel brought under the influence of their rays, as well as the sea for a considerable distance around the ship, thus enabling the presence of torpedoes to be readily discovered.

THE Indian Government has, we are informed, determined to inaugurate a complete system of torpedo defence for the whole of the Indian Coasts, and has applied to the War Office for the services of an officer to instruct officers and men in this new art of war. Capt. G. M. Collings, Royal Engineers, has been sent out, and will hold a position analogous to that of Lieut.-Col. W. Crossman at the War Office.—*Whitehall Review.*

THE telescope spar torpedo, a model of which was submitted a few days ago by one of the Woolwich laboratory artisans, named Griffiths, has been fired in the Thames, with a roughly-constructed apparatus. The spectators, who were taken out into the stream in a steam launch, saw only a couple of poles, each about thirty feet in length, lying along the deck, one upon the other, with a red disc at the extremity to represent a charge of gun cotton, and the other end made fast a little astern of midships. The practice consisted of taking aim at the floating buoys in the river, as the launch steamed past at full speed; and, simple as the affair looked, the effect was remarkable. Steering within a calculated distance of about fifty feet, the torpedo was cast overboard, when the tide and the motion of the vessel carried it out to arm's length, and at the same time caused the upper spar to stretch out in telescope fashion, carrying the torpedo head completely under the object attacked. It was the opinion of all who witnessed the experiments that the invention was capable of rendering useful service, and certainly to be preferred to the ordinary spar torpedo suspended over the bows of a vessel attacking end on, and risking its own destruction.

City Notes.

Old Broad Street, August 13, 1877.

AT the meeting of the Globe Telegraph and Trust Company the chairman was questioned concerning a rumour to the effect that the American Government were going to take some hostile step towards the Direct Company for entering into the arrangement with the Anglo-Telegraph Company. A day or two later a similar question was put to Viscount Monck at the meeting of the Anglo Company. The rumour has proved well founded. Last Wednesday the New York papers arrived here, and it was found they contained the following ominous text of a telegraphic message from the Secretary of State at Washington to the United States minister in London: "Give notice to the Direct United States Cable Company that the meditated arrangement, as understood by this Government, whereby that Company proposes to release its cable from the obligation of the fundamental clause of its organisation, prohibiting an amalgamation with, or participation in, the profits of other transatlantic telegraph companies, will be regarded by this Government as just cause for terminating its assent to the laying and working of the company's cable, and for severing its connexion with this company." In one of the New York journals particulars are given of a cabinet meeting at which Mr. Evarts reported the fact of an arrangement having been made between the two companies in regard to the transmission of messages, "which was a violation of the spirit of the Act of Congress." Mr. Evarts was then directed by the President to notify the Direct Company that the arrangement, which an American contemporary observes, "practically effects a monopoly," must be discontinued, or "this Government will not permit the company to use its coast as the terminus of the line." It is asserted that this news has come like a thunder-bolt to Mr. Pender and his associates. That may or may not be so. Mr. Pender, with his immense knowledge of business, ought to have anticipated that the United States Government would (to borrow the happy description of the leading journal) resent the attempt of the Direct Company to play fast and loose with agreements. But whatever misgiving Mr. Pender may or may not have had, it would be idle for him to deny that the Direct Company is, to say the least, placed on the horns of a most serious dilemma. We notice, indeed, that in replying to the interrogations put to him at the Globe Trust meeting, he was cautious to guard against committing himself to anything definite, merely remarking that the American Government had no cause whatever "to interfere with them." If Mr. Pender meant that the American Government had no cause to interfere with the Globe Company, he may be right. It is true that the chairman of the Anglo-American Company made a gallant endeavour to re-assure the shareholders. Viscount Monck boldly declared that "if the United States Government interfered with the Direct Company, the Anglo Company would, if necessary, certainly use the power which they possessed to stop such interference."

We have no idea of the nature of the power Viscount Monck refers to, but assuredly the time has now come for him to carry his threat into execution. Failing the board of the Anglo Company to the rescue, the Direct Company will either have at the eleventh, or twelfth, hour to break off the arrangement with the Anglo Company or to set the United States Government at defiance and withdraw its cable from the American coast. We imagine that Mr. Pender, amazing as his fertility of conception is, will be unable to suggest any other alternative. Of course, the best thing that could happen for the Direct Company would be the abrupt termination of the union with the Anglo Company. But even supposing such a thing to be still possible, we fear the Direct Company has a less fortunate fate in store for it. There was a time when prosperity might have rewarded the efforts of energetic officials, and not only might, but, in due course, would have done so, if one by name John Pender had not introduced the speculative element into the enterprise. The majority of the Direct shareholders, blind to facts, and deaf to warnings and entreaties, turned aside from the straight road to success; and they must now, unless we are greatly mistaken, reap as they have sown—reap, it may be, the whirlwind for the wind. If, then, the Anglo directors are not able to carry out their threat, and overrule the interference of the American Government,—Viscount Monck will pardon us for hinting that he may have been speaking under a delusion—and the American minister proceeds to carry out his instructions, we apprehend that many of those who were loudest in denouncing us for opposing the amalgamation of the companies, will be willing to grant that the last state of the Direct Company is worse than the first.

For, to dispose of the matter in a very few words, the withdrawal of the Direct cable from New York will inevitably involve enormous expenditure—cables are not laid down or taken up for a few hundred pounds—and may mean nothing short of complete disaster to the amalgamated companies. The American Government rightly refuses to countenance monopoly, affirming that the actual reason why the charter was given the Direct Company by Congress was in order to destroy monopoly. But it is clear that it will not stop at withdrawing the concession; it will give its charter to a company which will bind itself to faithfully carry out its engagements. Thus the competing company, which we have always averred to be something more than a remote chance, must already loom before the eyes of the shareholders, who have been wrought upon by the speculators' spells.

Americans do not waste much time in talking, and immediately it is absolutely settled that the Direct Company is to sever its connection with the United States, the scheme which was begun with so much promise by English capitalists will be taken up by New York financiers. Granting that a cable is laid, and a reasonable tariff for messages charged, what will be the effect upon the receipts of the Anglo and Direct Companies? How then about the boast of having bought out competition? When it is all too late the soundness of the advice we have given from the outset of the negotiations may be recognised. It is ever so. While folly has its dominion in the world, people will shut the cage after the birds have flown.

We have left ourselves little space to refer to the meetings of the Anglo-American and Globe Companies. But the message of the American Government to their minister in London is the absorbing topic of conversation with every one interested in the cable companies. Moreover, it has obviously a most important bearing upon the meetings in question. To the Anglo, no less than to the Direct Company, it may presage long-continued adversity, if not death itself. It need hardly be added that the future of the Globe Company mainly depends upon the future of the Anglo.

That the future of the Globe Company was not too hopeful, even before the startling declaration of the American Government was made known in England, is apparent enough from the proceedings of the half-yearly meeting. Mr. Pender did his best to persuade the shareholders present that they had no reason to suppose the prospects of the company were anything but reassuring;

but when there are not only diminished dividends, but complaints about diminished dividends, the prospect is not cheering. Confidence is comparatively easy to obtain; once shaken, it is almost impossible to restore it. The faith which Globe shareholders originally held in Mr. Pender and his co-directors will wax weaker and weaker.

It is something though, that it has actually dawned upon Mr Pender's mind that the work of amalgamation may be proceeded with too quickly. Even he, the exponent, through evil and through good report, of the motto, "Union is Strength," is compelled to do battle with some of his own shareholders, whom he has "educated" with a vengeance. "The present moment," urged Mr. Pender, "is not opportune for attempting to amalgamate all the Companies." We quite agree with the chairman of the Globe Trust Company. The present moment, the moment when the shareholders of the Direct Company are gnashing their teeth because they allowed themselves to be induced to give their consent to a union with the Anglo, is not opportune for attempting to amalgamate all the companies. And though, finally, the Globe report was "unanimously adopted," and votes of thanks tendered to the chairman and directors, we are pretty sure of one thing—that Globe shareholders who realise at once are wise men.

At the time the half-yearly meeting of the Anglo-American Company was held, the chairman was, no doubt, in blissful ignorance of the fact that a rude awakening was in store for the shareholders of the company, otherwise, he would scarcely, in apologising for a reduction in dividend, the result of a diminution in receipts, have congratulated his audience upon the fact that the hostile competition of the Direct Company had "happily entirely ceased." The hostile competition of a stronger company than the Direct must be still more prejudicial to the interests of the Anglo. It was very pleasant to the Anglo shareholders to be on an "amicable footing" with the Direct Company when the former fancied they had "bought out" competition. We question if the footing will be amicable when they find they have bought out competition to no purpose.

If the Anglo-American and Direct Companies had, undisturbed by speculation, been permitted to pursue the even tenor of their way, they might both have done well. It will be proved to the hilt that the introduction of the speculative element has had a deplorable effect. The public will, at the earliest opportunity, decline to pay the rates charged by the two companies, while the shareholders who depend for a respectable dividend upon the custom of the public, may have not merely to put up with any dividend or none, but to suffer positive loss. We foresaw these things long since, but the voices of Mr. Pender and his friends prevailed over our warnings. How is it that after the services Mr. Pender has rendered to telegraphy and telegraph shareholders we hear nothing further of the testimonial which was to have been the crown of a distinguished career?

We are always glad to be able to venture upon ungrudging congratulations. Of the two it is almost pleasanter to everybody to condemn or be condemned outright than to damn or be damned with faint praise. The report and statement of accounts of the Cuba Submarine Telegraph Company are all that can be desired. Out of a balance available for dividend of £14,439, the directors have placed £4,625 to the reserve fund (a wise step we think), which now stands at £20,000; and after providing for the preference dividend, they have declared a dividend on the ordinary share at the rate of 8 per cent., still leaving a sum of £414 to the credit of the current account. The details of the accounts are as satisfactory as the general result, which it will be allowed is saying a great deal.

On the whole, the dividends declared during the past fortnight by the different railway companies are encouraging. The London and North-Western is at the rate of 6 per cent. per annum, the London and South-Western, in spite of indifferent management, at 4½, and the Great Northern at 4. At the half-yearly meeting of the Great Eastern Company, the chairman vainly endeavoured to show that everything had been done that could be done to promote the interests of the shareholders. The shareholders did, as we anticipated, allow £36,000 for the renewal of permanent way, or as Mr. Parkes prefers to describe the transaction, a portion of that amount, "consisting of exceptional items," to be carried to a suspense revenue account. It did not transpire, and no one seems to have been curious enough to ask the question, what the exceptional items consisted of. In the end the report of the directors was adopted, and they are now free to go on blundering for another six months.

In striking contrast to the way in which the affairs of the Great Eastern Company are conducted is the *modus operandi* of the Metropolitan District Board. A dividend of 5 per cent. is to be paid out of the half-year's profits on the preference stock, and the chairman was able to do more than hold out a shadowy hope that the company would have a prosperous career. Yet the District Company is a small enterprise only recently originated, while the Great Eastern is one of the oldest and most powerful companies. It would be also one of the most profitable, but for stupidity or negligence, or both.

THE lecture to the working men annually given by the British Association will, this year, be delivered by Mr. Preece. The subject will be "Telegraphy, and its Recent Progress." Duplex and quadruplex telegraphy will be illustrated; and, for the first time in England, the real articulating telephone, which Mr. Preece has brought over with him from America, will be exhibited. He hopes to hear the voice between Exeter and Plymouth. The lecture is looked forward to with much interest.

WE regret to have to announce the death of Col. Robinson, R.E., the Director-General of Telegraphs in India. He died at sea on the 7th inst. He had been at the head of this department for nearly ten years, and had completely revolutionised it. When he took it in hand its administration and condition was at zero point. He has left it one of the best organised telegraph departments in the world.

Correspondence.

London, August 7th, 1877.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Allow me to correct a short notice contained in your No. CVIII, 1st August, page 178.

This Company has had direct cable communication between Russia and Sweden for the last seven years; but finding the traffic increasing, a second cable has now been laid from Nystad in Finland, touching Godby on one of the Aland Isles, and then proceeding to Grisslehamn in Sweden. The old cable will be used for the transit traffic, whereas the new cable will be mainly used for the local traffic.

I am, Sir, your obedient Servant,

H. G. ERICHSEN.

The Company's Representative in England.